On the origin of apparently negative minimum susceptibilities of hematite single crystals calculated from low-field anisotropy of magnetic susceptibility

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As shown in the literature several times, the calculation of the anisotropy of magnetic susceptibility (AMS) of hematite single crystals using standard linear AMS theory reveals that the calculated minimum principal susceptibility is parallel to the crystallographic c-axis, but is negative, which is however not due to diamagnetism as evidenced by direct measurements of susceptibility along the principal directions.

Susceptibility of a few hematite single crystals from Minas Gerais, Brazil, was measured in 320 directions using a special 3D rotator and the measurements were processed through AMS calculation by means of standard linear theory and through constructing contour diagram in equal-area projection. In addition, the deviations of the measured directional susceptibilities from the directional susceptibilities calculated from the fitted AMS tensor were calculated. The crystals show extremely high anisotropy, the susceptibility measured along the basal plane is several hundred to several thousand times higher than that along the c-axis and the AMS ellipsoids are very oblate, nearly rotational. The contour diagrams show relatively simple patterns of directional susceptibilities, similar to those of the second-rank tensor. However, the calculated AMS ellipsoids are slightly more eccentric than is the surface connecting the directional susceptibility values. The present study is assessing whether, realizing that the susceptibility along the c-axis is about three orders lower than that along the basal plane and taking into account the directional distribution of the fitting errors, one can ascribe the existence of the negative minimum susceptibilities calculated through standard linear theory to imperfect techniques of second-rank tensor fitting rather than to complicated magnetization mechanisms.